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ABSTRACT

Experience has shown that the quality of instruction depends on the occupational competency of the teacher. The overall purpose of this project is to develop occupational competency examinations for nationwide use in evaluating trade and industrial education teachers. This first phase of the two-phase project involves: (1) surveying the state of the art, (2) preparing a handbook with guidelines and basic principles, (3) developing and pilot testing written and performance tests in electronics-communications and the machine trades, and (4) developing the structure for a consortium of states to implement the program. Test validity and reliability will be established in the second phase. The survey of the state of the art shows excessive duplication of effort, lack of coordination, and deficient data, all of which point out the need for a national consortium. Lists of resource materials and organizations are appended. (BH)

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NATIONAL OCCUPATIONAL COMPETENCY TESTING PROJECT

VOLUME 2

JAN 22 1971

PHASE ONE
Organizing, Planning, Pilot Testing
and
Establishing the Feasibility of a
Consortium Concept

Report on

THE STATE OF THE ART OF OCCUPATIONAL COMPETENCY TESTING

By

Adolf Panitz C. Thomas Olivo

Research Project Grant No. 8-0474
to
Department of Vocational Technical Education
Graduate School of Education
Rutgers, The State University, New Brunswick New Jersey

By the U. S. Department of Health, Education and Welfare
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NATIONAL OCCUPATIONAL COMPETENCY TESTING PROJECT

A Consortium for Occupational Competency Testing
Of
Trade and Industrial Technical Teachers

PHASE ONE
(Organization, Planning, Pilot Testing)

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A Report on

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Research Project Grant 8-0474 to

The Department of Vocational-Technical Education

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Rutgers, The State University, New Brunswick, N.J.

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United States Department of
Health, Education, and Welfare

Office of Education
Bureau of Research

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FOREWORD

For an industrial nation which constantly accelerates its technological skills and knowledge, the rate of growth depends upon the productive potential of the available labor force. Leaders of the industrial sector of the nation, and those concerned with utilization of the products and processes of industry, recognize that the socioeconomic well being of the people, their health and the national security are inseparable from manpower development potential.

For some, this means preparation for initial employment. Others, in the labor force, may require upgrading or extension training, so that they may perform at levels requiring higher skills and technical knowledge or serve middle management as foremen, supervisors or managers. Those who may be displaced, or need to prepare for employment in other occupational fields, require retraining.

Whether vocational education relates to the preparation of youth, new workers, or the retraining or upgrading of adults; whether the training is carried on in educational institutions, industry or the military, there is a force, common to all to make the potential manpower actual manpower, and that force is the occupational competence of those who serve as teachers.

Within the United States and other industrialized nations, the demand for highly skilled craftsmen and technicians to prepare themselves for teaching is rapidly growing. Unlike other teachers, those who serve in trade and industrial education and training develop their subject competencies in actual live situation through full-time "hands on" employment.

Experience has shown that the quality of instruction, whether for a beginning learner or advanced craftsman, depends directly upon the occupational competency of the teacher. Thus, the need for instruments for the evaluation of the practical skills and related technical competency of potential teachers becomes obvious.

Phase One, of this project, sought to establish the feasibility of pooling national resources into a Consortium of States for occupational competency testing, and to develop and apply the most effective methodology to the preparation, administration, pilot testing, evaluation and reporting of two occupational competency tests in two major trade and industrial/technical occupations.

For a starting point, it became necessary to establish certain "bench marks". This part of the project relates to people and organizations involved in developing adequate measures for occupational competency. Their experiences and the results of their efforts were carefully reviewed and are here recorded as the Report on "The State of the Art" of occupational competency testing.

Acknowledgment is made to those who assisted in this massive undertaking. Space does not permit to name all the persons who have cooperated. Appendix D includes all the organizations which participated. However, recognition must be extended to the principal investigators whose perseverance achieved recognition of the critical need for occupational competency evaluation, and who were instrumental to obtain the financial support to carry on this project.

Credit is due Dr. Carl Schaefer for initiating the proposal, and providing leadership from the preliminary stages to the funding, and the successive stages of implementation.

Dr. Melvin Barlow, Dr. Richard Nelson, and the Project Director who, with Dr. Schaefer represented the Principal Investigators, actively supported the project through the various phases. Recognition is, also, extended to the Planning Committee for direction, review of project materials, and active assistance. The Committee was identified on a preceding page.

Among the individuals who contributed generously of their time and counsel, Dr. Gordon McMahon provided the project with materials resulting from many years of experience in New York in Occupational Competency Test Development. Mr. James Peterman, Educational Advisor at the Great Lakes Naval Training Center; Dr. R. O. Waldkoetler, Chief, Evaluation and Analysis Branch, Enlisted Evaluation Center, Ft. Benjamin Harrison, Indianapolis; Mr.J. Mangiaracina and Mr. Carl Rudsinsky, Army Signal Corps Training School, Fort Monmouth, New Jersey extended wholehearted cooperation to the visiting team and made valuable practical information available. Helpful assistance was, also, rendered by Mr. Carl Schiemer, Assistant Director, Examination and Recruitment, New York State Civil Service.

This report consists of four parts. Part One provides the background, rationale and resources of the study. Part Two includes the research studies and literature relating to occupational competency testing. The experiences with occupational testing materials and practices throughout the United States and the Territories are reported in Part Three. Occupational testing materials and programs of industrial, governmental, labor and military organizations are reviewed in Part Four. A summary of the findings of occupational competency and recommendations resulting from the study are presented in Part Five. Four Appendices of significant resource materials, which were examined, complement this report.

The conclusions are those of the authors. The contributions to vocational education which may result from this report we gladly share with the many who have so wholeheartedly cooperated, and offered support when it was most needed. However, the responsibility for the point of view expressed and for any errors of omission of commission which may have occurred, is ours.

C. Thomas Olivo
Project Director

Adolf Panitz,
Associate Director

New Brunswick, New Jersey
June 14, 1970

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PART ONE

BACKGROUND, RATIONALE AND RESOURCES FOR THE STUDY

I. OCCUPATIONAL COMPETENCE: THE KEYSTONE OF QUALITY TEACHING

The level of occupational competence of the teacher, of trade and industrial education, is the keystone upon which the whole instructional program is built. This position recognizes that the prospective teach must also possess personal qualities, professional preparation in a quality teacher training program, and other qualifications which collectively insure success in teaching. Foundationally, there must be evidence that the range of occupational competence is adequate to meet the full spectrum of needs of in-school and out-of-school youth and adults. This occupational competence is essential for teaching in public and private schools, industry, governmental agencies, the military; whenever skills are to be developed and the related technology mastered for a trade, industrial service or industrial technical occupation.

A few states have been able, with varying degrees of success, to develop or participate in establishing the occupational competence of prospective teachers. The development, administration and validation, of occupational competency tests requires human and material resources and finances that are in short supply even in leading and heavily populated industrial states. At the same time, all states recognize the earlier stated truism that instructional excellence must be rooted in the occupational competence of each teacher.

Many state officials have stated frankly that their departments are not equipped to develop new examinations, keep old ones up to date, or even develop a single trade or industrial test. There is agreement that the developing, printing, distribution, administration, scoring and validation of occupational competency tests imposes an unrealistic burden and that no single state has adequate resources of dollars or experienced personnel to resolve the problem.

II. STEPS LEADING TO THE ACCEPTANCE OF THE CONSORTIUM CONCEPT

Two one-day institutes at Rutgers University (1966), attended by representatives of twenty-three (23) states, concluded that the development and implementation of an occupational competency examinations program on a nationwide basis would be a more efficient use of personnel and would provide higher quality examinations. Almost unanimous agreement was reported that such examinations would be used.[1]

These same states and ten additional ones who met in Chicago on March 13-14, 1970, except for two abstentions, stated unanimously their endorsement of the concept of a consortium of states arrangement, and their willingness to participate in a National Occupational Competency Testing Program.

Everything the staff researched and every person and agency contacted revealed the common problems: The military with their highly specialized tests, industry, educational testing, services, labor--all reinforced the basic facts of life

(a) that occupational competency was a prime requirement for the teacher,

(b) the instruments and techniques each was using for measuring occupational competency of teachers of trades and industry were not as reliable, valid or practical as each indicated they should be,

(c) no single agency had all the essential resources of hardware, knowledge, finance and skilled testing personnel,

(d) their efficiency and effectiveness in occupational competency testing required the cooperative pooling of human and material resources, and

(e) the national consortium concept advanced a plan worthy of endorsement and implementation.

So, the time was right to secure, review, assess present practices and report the findings, and establish a point of reference for the whole movement. In essence, this was the purpose for this intensive survey and study of the State-of-the-Art in occupational competency testing.

III. OVERVIEW AND OBJECTIVES OF PHASE ONE

The present project includes two phases. Each phase involves research, test preparation, pilot testing, the gathering and analysis of data relating to the tests and testing and the establishing of principles of operation and procedures essential for the development, organization and administration of a consortium of states for a National Occupational Competency Testing Program.

The outcomes of Phase One should establish the feasibility of

(1) developing trade and industry teacher competency examinations acceptable to the many states by actually developing and piloting such tests, and

(2) laying the groundwork on which to proceed if the states accept the consortium concept. Phase Two would relate to establishing validity and reliability by in-depth testing, developing a significant number of trade and industrial competency tests to assure success in a consortium arrangement and to make the total plan operational.

A. Scope of Phase One

Phase One involved:

(1) A survey of the state-of-the-art of occupational competency testing of teachers of trades and industry to determine:

   a. the extent to which occupational competency tests are being used in the various states,

   b. the practices and procedures of occupational competency testing employed by industry and/or labor organizations,

   c. the methods and procedures of occupational competency testing used by the military,

   d. the methods and procedures of competency appraisal used by government agencies (civil service),

   e. the availability of tests prepared by private research organizations.

(2) The establishment of basic principles and the preparation of guidelines for the development and administration of written and performance tests for qualifying prospective vocational industrial teachers. The material resulting from this work will be printed as a Handbook on Occupational Competency Testing.

(3) The development, reproduction and pilot testing of written and performance tests for the Electronics Industries Occupation (Communications) and the Machine Industries Occupations (Machine Trades).

(4) The defining of guiding principles, policies, and a basic operating structure for the establishment of a consortium of states, the bringing together of interested states to explore their interest and to establish a base for implementing the concept.

IV. THE NEED FOR A SURVEY OF THE STATE-OF-THE-ART

A number of states--California, Florida, Michigan, New York and Pennsylvania, have introduced competency examinations for admission to vocational industrial technical teacher education programs, for certification, and for credit for undergraduate and graduate programs of study. A survey by Schaefer, conducted in 1959, showed that 16 states were then using tests to evaluate occupational competency.[2] In a more recent study, by Kazanas and Kieft,[3] involving a review of State Plans, it was found that 11 states used trade competency tests to help certify vocational education teachers. In the same study, 8 state plans provided for the use of occupational competency tests; 5 other states use competency tests, although no special provisions were included in their state plans for such purpose. Editorially, it should be stated that members of the Planning Committee indicated that many other states require the satisfactory passing of an occupational competency examination for entrance into the teacher training program, even though such detail may not appear in the state plans.

Recent discussions with officials responsible for vocational education and teacher certifications in several of the states revealed that considerable dissatisfaction exists with the quality of the tests now in use. These tests are largely of the paper and pencil variety with some requiring actual performance in simulated job situations. There is little evidence to indicate that test questions were pretested, or that the instruments were validated according to acceptable test development procedures.

V. CONCERNS OF OTHER RESPONSIBLE AGENCIES

Evaluating occupational competence of tradesmen and technicians is not necessarily confined to future vocational teachers. Industrial employers, government agencies, the military, and labor organizations are also faced with evaluating the occupational competency of individuals for adequate performance in their jobs. Since each organization has a similar problem of occupational competency evaluation, it is reasonable to assume that these organizations have done work in this area. Therefore, a survey of the "State-of-the-Art" must extend beyond the practices of the various vocational education units in the states and include a review of existing test procedures in somewhat related areas, field visits and observations, as well as a search of published related materials.

VI. IDENTIFICATION OF RESOURCES

The first step in the "survey-of-the-art" of occupational competency testing involved the locating and collecting of as much relevant information as possible. It was recognized that such effort involved a multiple approach which included a review of the literature on competency testing, field visits and observation of existing practices, as well as personal and/or mail contact with State Directors of Vocational Education and other professional personnel in each state, the District of Columbia; Virgin Islands and Puerto Rico; Government Agencies (Federal, State and Local); Civil Service Agencies; the Armed Forces; Private Research Organizations; Business; Industry; and Labor Organizations.

Additional contacts were made through professional organizations, such as: National Association of State Directors, the National Association of Industrial and Technical Teacher Educators, the Research Committee of the Trade and Industrial Education Division, American Vocational Association; and the National Vocational Education Research Centers at Ohio State University and North Carolina State University; the University of Wisconsin Center; the various State Vocational Education Research Coordinating Units, and the American Psychological Research Association.

Referral to other resources were made by the American Management Association, the National Association of Manufacturers, Associated Electrical Industries; National Tool, Die and Precision Machining Association; American Association of Industrial Management, and the Industrial Conference Board. Private research and contract organizations involved in the field of testing, such as: the Psychological Corporation, Educational Testing Service, Science Research Association, were also contacted.

Among organized labor, the National Labor Organizations, who carry on some form of occupational competence evaluation for plumbers, carpenters, machinists, and electrical craftsmen, were contacted.

PART TWO

RESEARCH STUDIES AND LITERATURE RELATING TO OCCUPATIONAL COMPETENCY TESTING

I. SOURCES AND NATURE OF OCCUPATIONAL COMPETENCY TESTING AND RELATED RESOURCE STUDIES

The review of literature search and analysis centered around all printed reports on occupational competency tests. Work was carried on in the libraries of Columbia University, New York City Central Library, New Rochelle Library, the Library of the New York State Education Department and the Library of Congress.

Additional research work was done at the National Center for Vocational-Technical Education, the Ohio State University; and through ERIC. Abstracts of research and related materials for vocational-technical education for the period 1967-69 were reviewed in the ERIC library for contributing experiences and related information. This search, in the specialized areas, produced only four studies somewhat related to occupational competency testing but primarily concerned with teaching competence of instructors in vocational education.[4] One study related directly to occupational competence.[5]

A search at the Wisconsin Center for Studies in Vocational and Technical Education revealed the same studies as Ohio.

In the libraries, the catalogs and abstracts, pertaining to testing, and the general catalogs were checked for materials on occupational competency testing. The search was extended to include periodicals, magazines and special publications of the American Psychological Association and the American Psychological Research Association. In addition, textbooks on testing and occupational testing were reviewed. Only two volumes were found that concerned themselves with construction, administration, evaluation and validation.[6] One of these publications is out of print.[7]

A. Occupational Competency Tests Based On Trade Analyses

Evaluation of occupational competency is becoming increasingly important for teacher certification. Kazanas and Kieft[8] concluded that:

(1) well designed examinations have value in teacher certification, and

(2) examinations can be effective in determining teacher competency, increasing the number of teachers, and in indicating weaknesses of those who fail.

Their conclusions were based on oral, written and performance examinations which were developed from several trade analyses combined for each trade area to form a comprehensive analysis. This analysis was revised by the research staff and teacher educators.

Approximately, 1500 test items were prepared for each trade area. These were screened, evaluated and divided into three separate forms for each trade. The committee who evaluated the written examinations also made recommendations concerning performance test content and developed a list of practical tests for the evaluation of manipulative skills. As of this date, validity, reliability, and general usefulness have not been established. This work is expected to be completed in Phase II of their project.

B. Evaluation Of Teaching

Popham, in his final report: "Performance Tests of Instructor Competence for Trade and Industrial Education",[9] described teaching proficiency tests for automotive mechanics (carburation) and for electronics (power supplies). An assessment was made of each test's ability to distinquish between the experienced teacher and the non-teacher with respect to his ability to achieve pre-specified instructional objectives.

All participants were given sets of operational defined objectives. They attempted to achieve goals during an instructional period of 10 hours. Pre and post-tests, based explicitly on the objectives, were given to the students of each participant. Average class achievement was used as an index of the teacher's proficiency.

Comparison of student performance data revealed systematic differences between the performance of teacher and non-teacher groups in auto mechanics or electronics. Results were attributed to problems associated with the training of teachers, as well as the reinforcement structures operating when they commenced training. This project involved an evaluation of teaching rather than occupational competence.

C. Impact of Educational Variables On Professional Competencies

In the study "Professional Competencies of Teachers of Tech nical Education in Florida", Kurth and Giannini[10] attempted to determine whether the professional competency of technical education teachers was a function of several educational background variables. Teachers were judged on the basis of a basic comprehensive examination, a sociometric rating of professional colleagues and the level of cooperation shown during the study. Among the background variables were the amount of occupational experience other than teaching and the classification of other occupational experience.

The authors concluded that there were no significant differences between the college attended, time intervals between degrees and certification, and the number of years employed in other occupations. It is difficult to appraise the role assigned to occupational competence in this study. No detailed explanation was given as to the content of the basic comprehensive test nor how experience was appraised other than in years of service.

D. Collegiate Credit For Validated Occupational Competence

A great deal of concern is voiced about granting college-university credit for trade and industrial experience in vocational industrial-technical departments, and by certification units of State Departments of Education. Lauda[11] surveyed 201 colleges and universities. The results showed that one-fourth of the institutions surveyed grant credit for trade and industrial experience; others planned to do so. Significantly, he mentioned that most institutions use a combination of written, oral and skill tests to evaluate competence before granting credit. The New York State University College, Oswego grants credit when proof of competency is demonstrated through successful passing of a test. Candidates are eligible to take the test only after they have offered proof of the required experience. Unfortunately, no explanation was offered as to the types of examinations employed, their validation and reliability, and the method of administrative control.

E. Validating Occupational Competence Through Trade Competency Tests

New York, California and Pennsylvania have utilized written and performance tests for a number of years as part of the whole process of establishing occupation competence, as a pre-requisite to teaching in a trade or vocational industrial area. Koenigsberg and Reilly [12] investigated the reliability of New York State's written and performance examinations; i.e. do the examinations yield scores that are relatively stable for any individual. Also, in terms of the validity of the written and performance examinations, do they reflect the areas in which the applicant should possess skill or knowledge (content validity), and do the examinations differentiate the applicant's degree of skill or knowledge.

The proficiency examinations presently in use were developed statewide over a period of years and were essentially "teacher made". The test items were written by trade and industrial teachers using a guidebook that had been prepared and refined continuously by the vocational industrial teacher training staff as part of the Bureau of Industrial Teacher Training of the New York State Education Department. It was assumed that these tests were valid and reliable prior to the present study. The three most widely used examinations, Auto Mechanics, Cosmotology and Machine Trades, were selected for investigation and further revision.

It should be reported that, in the last five years, the industrial teacher training function was transferral from the New York State Education Department to newly established Divisions of Vocational Technical Education at State University College at Oswego and Buffalo, and the City University of New York. Since that time, the function of occupational competency development and coordination has been carried on at Oswego under the leadership of Dr. Gordon McMahon, Division Director. Funds were provided for the Koenigsberg-Reilly study by the New York State Education Department.

F. Establishing Test Reliability

The final report of this study discusses the methods employed to process examination information by computer and other data processing equipment. An item analysis was performed, including the difficulty index (the percent passing each item), and the point biserial coefficient (a correlation of the item with the total test score).

For appraisal of reliability, the Kuder-Richardson Formula 20 was employed which yields a measure of internal consistency. "If the items on a test have high intercorrelation with each other and are measures of much the same attribute, the reliability coefficient will be high. If the intercorrelations are low, either because the item measures different attributes or because of the presence of error, then the reliability coefficient will be low", Ferguson [13], 1966.

Another estimate of the reliability of an examination employed was the standard error of estimate. The standard error of measurement is the standard deviation of a sample of scores for an individual around his true score. The greater the ratio between the standard error of measurement and the standard deviation of the test, the more reliable are the test scores. Additional important reliability data, dealing with difficulty levels and point biserials, were processed by the authors and reinforced the information obtained by other methods.

For the performance tests--the interjudge reliability of the examiners--the rating scales for each pair of judges were compared to determine the extent of agreement on the ratings. A high degree of correlation was obtained. This study established the feasibility of using statistical item analysis and cross-validation procedures to assess and improve the effectiveness of occupational competency testing programs. The results of this study established the need for further revision and improvement of examinations. They also indicated that examinations designed by teachers tend to include test items known to teachers but not necessarily to practitioners in the trade or technical occupation.

G. Significance of Correlation Between Written And Performance Test Scores

Another study by Reilly [14] was concerned with norms patterns applied to the selection of trade and technical teacher candidates. The data treated included: region of the state, age, field (occupation), IQ score, written occupational competency test score, performance test score, State University of New York examination score, years experience, course grades, and number of courses taken.

The report on this study includes a profile of the trade and industrial teacher candidates. However, Reilly cautions that the typical member of any sample of applicants probably does not exist. Nevertheless, such a description seems useful in trying to understand the nature of the candidate sample. From this study, it appears that trade knowledge (theory) and trade performance (practical) tests are not highly correlated, and that written examinations alone are a poor indicator of trade competence.

This conclusion is supported by Stuif who carried on extensive work in performance measures for the Navy during World War II [15]. Stuif says, "Although it had been assumed that written tests sufficed to indicate what a man had learned in a service school, the evidence showed that performance tests and improved shop grades were not closely related with written test grades".

Editorially speaking, the project director and associate director support the position expressed by Dr. Edward Hankin, [15A] a member of the Planning Committee and an experienced authority on tests and measurements, particularly occupational competency testing for trade and industrial education teachers, in a careful review of this report:

> ".....that the correlations should be high if the study population, from which the scores are drawn, represent a normal range of competency from low to high. Hankin found, rather consistently, that if such correlations are low, one or the other of the tests, usually the written test, is weak. Conversely, merely refining a written test will increase substantially the correlation.
>
> "It might be pointed out that there is a theoretical base for expecting high correlation in this situation. Otis gives one method of interpreting a coefficient of correlation as follows: 'A coefficient of correlation may be thought of as the decimal fraction which tells what proportion of the causes affecting the magnitude of two variables are common to both variables.' Since, in this case, there is one 'cause' (occupational training and experience) to measure with the two variables (written and performance tests) and, if the scores of these tests both reflect only the one and the same cause, perfectly valid tests (theoretically) should produce a perfect high correlation. This, of course, is not practical.

"The notion that if there is high correlation only the written test would be needed derives from other fields of testing, such as mental ability, where the intention is to isolate independent traits like space perception and verbal reasoning. Here a low, or even negative correlation, is needed to show them as independent. In measuring the occupationally competent worker, he has both types of abilities (as measured by the two types of tests), and they are not independent. High correlation of the examinations is no basis for assuming the candidate has skill and technical competence because he has one or the other."

"The mere fact that much that is in the written tests might be mastered simply by classroom instruction and study would make the written test the poorest basis for such an assumption."

"By such means, written and performance tests, the breadth of competency can be checked. If only a total score is produced, each individual's competencies are "averaged out". Two people with the same score might be quite different in their competency and there is no clue as to what their differences are or even that they are different. For example, if there were two auto mechanics, one might have limited experience or none on engine tune up and the other none on chassis work. Thus, the subtest scores are valuable also for their diagnostic value in establishing the candidate's capability across many major parts of a trade."

Reilly[14] touches on another problem presently under serious discussion; namely, the number of years of experience essential for teaching in vocational industrial education and training programs. In this study, the correlation between five years of journeyman experience and all other variables was negligible. All candiates had five years or more years experience at the journeyman level. Reilly concludes that occupational experience beyond five years, at the journeyman level, is not important. This conclusion could be challenged by the limited scope of the study. In view of the importance of this issue and the difficulty in some states of recruiting competent people with appropriate experience, further research on the number of years of experience required is essential. Part of the problem may relate to salary structure in comparison to industrial wages.

II. OTHER APPROACHES TO MEASURING ACHIEVEMENT

In a final report concerned with the Development of a Model Vocational Teacher Education Program, Miller[16] proposes an occupational testing program somewhat different from those in other states. A competency test is proposed for measuring, gaging and layout work which a trade and industrial teacher should be able to demonstrate, supplemented

by another list containing 136 items in the area of machining. The report does not indicate that written and performance examinations have been developed, nor is there any indication how such tests are to be validated.

A still different approach to measure student achievement is being developed by Baldwin [17]. This extensive study is primarily concerned with the level of achievement attained by students in post high school trade and technical programs. Emphasis is placed upon a conceptual framework for classifying the behavior to be measured in each of eight curricula. These tests are being validated on student populations after one year of training for segments of the various trades. At this point, it is doubtful whether the results will be applicable to the competency evaluation of future trade and technical teachers.

III. STATE EFFORT AT EXTENSIVE TESTING TO ESTABLISH RELIABILITY AND VALIDITY

California has carried on occupational competency testing for a number of years. In a brief paper, Lofgren [18] describes the efforts made and the procedures employed. For illustration purposes only, he has selected the auto mechanics competency examination to describe item analysis, measures employed to establish reliability and the factors involved to validate the test. Two measures of test reliability were used. The primary reliability coefficient (Kuder-Richardson) is based on the concept of "rational equivalence" which stresses the consistency of the subject's responses to all items on the test and, thus, provides a measure of the internal consistency of the test.

The second measure (Gutman) is a split half-index which estimates total test reliability by subdividing test items into two subsets and provides an estimate of the equivalence of the two test scores. Both of these coefficients can be computed upon a single administration of the test. This is important in the practical aspect of test development.

While there may be a question on the comparability of the resulting estimates on theoretical grounds, in actual practice the obtained difference would not be very large. If large differences occur, it may be an indication that the test probably contains heterogeneous items; that all parts of the test are not measuring the same thing.

The validity of the test was analyzed to see how well it correlated with the criteria it was supposed to measure. Lofgren emphasizes the difficulty of obtaining adequate criteria. Two validity criteria were established. The first involved the number of years of work experience; the second, that of former employer

ratings of the journeymen auto mechanics involved in the sample. A modified tetrachoric correlation formula was used in the statistical treatment.

Included in this paper are the formulas employed and statistical tables resulting from the treatment of the data. The importance of this paper lies in the attempt to develop occupational competency tests, in accordance with accepted test development procedures. While there may be disagreement on some of the details and the actual means employed, nevertheless, this work is a step in the direction of developing better tests. This paper was limited to written tests and contained no information on performance tests.

IV. EXTREMELY LIMITED RESEARCH ON OCCUPATIONAL COMPETENCY TESTING

A great deal of material has been published dealing with intelligence, attitude, aptitude and achievement in academic subject areas. Some tests have been developed to evaluate office occupations, particularly: typing, shorthand and transcriptions. For other occupations, little or no research has been published. Several tests in auto mechanics, machinist and lathe operation are briefly described, but no evidence of validation and reliability is indicated. The "Mental Measurement Yearbook", 3rd, 4th, 5th and 6th editions[19], and Buros' "Tests in Print" [20] provided very little additional information on the research carried on in occupational competency testing, or in the availability of tests through private organizations.

The review of the literature confirmed the earlier belief of the principal investigators, study staff, planning committee, and other vocational industrial leaders of the extremely limited amount of recorded experiences about occupational competency testing. This is appalling, in view of the fact that a few states have required the satisfactory passing of an occupational competency examination to measure and validate occupational experience for over 40 years. The situation is further aggravated when industry, government, the military, and others need to place such dependence on the results of valid measures of occupational competence. At this point, Shimberg's cryptic remark is noted:

> "When one considers the importance of performance evaluations to the future of vocational education, it seems inconceivable that so little progress has been made." [21]

PART THREE

OCCUPATIONAL COMPETENCY TESTING MATERIALS AND PRACTICES THROUGHOUT THE UNITED STATES AND TERRITORIES

I. APPROACH TO STATE CLEARANCES AND SOURCES OF INFORMATION

State Directors of Vocational Education, State Supervisors of Trade and Industrial Education, Head State Trades and Industries Teacher Educators and individuals in charge of State Research Coordinating Units for Vocational Education were the lead persons contacted by letter. The rationale, the vocational objectives, and scope of the project were explained soliciting their assistance to provide specific relevant information needed for this research effort. These requests were supplemented by a brochure entitled, "Occupational Competency Testing". The following indicate the type of information requested from the states:

1. A list of titles of tests which has been prepared,

2. Titles of other tests in preparation, as either revisions or new tests,

3. Plans for the future development of occupational competency tests, or establishing a testing program, or test procedures,

4. Samples of written and practical examinations for
   a) the machine industries occupations (machine trades),
   b) electronics industries occupations (communication) and
   c) automotive industries occupations (automotive trades),

5. Guidelines for the construction of new tests,

6. Instructions for examiners giving tests,

7. Instructions for candidates taking tests,

8. Method of evaluation of test results

A second follow-up letter was sent to those states and institutions which did not respond at first. Table I represents the total number of replies received.

Table I - Responses to Initial Requests on Occupational Competency Testing Practices

	Contact Persons	Number of Requests Sent	Respondents	Percent Returns
1	State Directors of Vocational Education or equivalent	54	40	74
2	Head State Industrial Teacher Educators	63	37	59
3	State Research Coordinating Units for Vocational Education	46	8*	17*
4	State Supervisors of Trade and Industrial Education	56	42	75
	TOTALS	219	127	

* This limited response is recorded even though it does not portray an accurate picture. Many RCU directors turned the request over to an appropriate unit within the state that handles this function. In some instances, it was the head state industrial teacher educator; in others, a state supervisor, etc.

II. STATE USE AND DEVELOPMENT OF OCCUPATIONAL COMPETENCY EXAMINATIONS

In a few states, the examinations are developed and administered by the Division of Vocational Education within the respective State Departments of Education. However, in the majority of states, this task is carried on by Departments of Vocational Industrial Technical Education in one or more colleges or universities, approved by the State Departments of Education to conduct a Trade and Industrial Teacher Education Program. The listing in Table II indicates the states and/or the centers involved in occupational competency testing who responded to the inquiry:

Table II - State Practices for Developing Occupational Competency Tests

State	Agency or Institution Responsible for Test Development	Notes
California	Department of Education Bureau of Industrial Education, Sacramento	A major responsibility now is carried on within the Division of Vocational Education, Graduate School of Education, UCLA, Los Angeles
Colorado	Colorado State University, Ft. Collins, Dept. of Vocational and Technical Education	
Connecticut	Central Connecticut State College, New Britain	
Florida	Florida State University, School of Education, Department of Industrial Arts and Vocational Education, Tallahassee Florida A & M University School of Technology, Tallahassee University of Miami, Coral Gables	
Georgia	University of Georgia College of Education Division of Vocational Education, Athens	
*Hawaii	University of Hawaii, Honolulu	
Indiana	Purdue University Department of Vocational Education, Lafayette	
Kansas	Kansas State College Department of Vocational Education, Pittsburgh	

*Kentucky	University of Kentucky Department of Vocational Education	
Louisiana	Louisiana State University and Agricultural and Mech. College, Baton Rouge	
Massachusetts	State Department of Education, Division of Vocational Education, Boston	Specific information not provided as to extent of test use, purpose, etc.
Michigan	Eastern Michigan University, Department of Industrial Education, Ypsilanti Ferris State College, Big Rapids Wayne State University College of Education, Detroit	
Minnesota	University of Minnesota Department of Industrial Education, Minneapolis	Occupational Competency Tests for high school and post-high school students
Nebraska	Kearney State College, Kearney	
New York	State University Division of Vocational-Technical Education	Other Examinations are administered by: Division of Vocational-Technical Education, State University College, Buffalo and Division of Vocational-Technical Education, City University of New York
Ohio	Instructional Materials Laboratory, Division of Vocational Education, State Department of Education, The Ohio State University, Columbus	Occupational Competency Tests for high school and post-high school students. The Universities of Cincinati, Ohio State University, Toledo and Kent State use examinations for credit towards degrees in trade and industry education. The use of tests for certification is permissive not mandatory.

Oregon	Oregon State University, Division of Vocational-Technical Education, Corvallis	
Pennsylvania	Temple University, Philadelphia State College, College Park, University of Pittsburgh	Occupational Competency Testing is coordinated as a function of the State Department of Public Education
South Dakota	Southern State College, Springfield	
Tennessee	The University of Tennessee, College of Education, Department of Vocational-Technical Education, Knoxville	This university serves as a testing center for a consortium of southern and central states.
Texas	Texas A & M University College of Engineering, College Station	

* States or territories interested and planning to develop occupational competency tests.

The states and institutions shown in Table II use occupational competency examinations for three main purposes:

1. for admission of potential trades and industries teachers to trade and industrial teacher education programs;

2. for state certification, and

3. for admission to an undergraduate or graduate degree program.

Some states utilize these tests for one or two purposes; others for all three.

The information received from the respondents, about the trade examinations they have prepared, is recorded graphically in Table III. The total number of different tests prepared for the same trade are indicated. This, however, is not the total picture. For example, a few states that have developed occupational competency tests and administer them, in most of the trades given in the Table, did not respond and, naturally, are not reported. The information does provide some keen insights into needs and the major trades in which test development is concentrated.

Table III - TRADES AND STATES IN WHICH OCCUPATIONAL COMPETENCY EXAMINATIONS ARE ADMINISTERED

		Air Cond. Refrig.	Aircraft Eng.Mech.	Arch. Drafting	Auto Body Design	Auto Body Repair	Automotive Mech.	Carpentry Cab.Mak.	Civil Tech.	Comm. Art	Cosmotology	Data Processing	Die Designer	Die Maker	Diesel Mech.	Drafting	Draft & Des.Tech.	Elect. Const.	Elect.&Electronics	Elect. Service	Electronics Mech.	Farm Mech.	Food Trades	Heavy Equipment	Hydraulics	Machine Trades	Masonry	Nursing	Office Occup.	Paint.& Decorating	Photography	Pipe Fitting	Plumbing	Pneumatics	Printing	Radio - T.V.	Sheet Metal	Sign&Poster Design	Small Appl. Repair	Tool Design	Tool Maker	Upholstery	Welding
1.	California	x	x		x	x	x	x			x		x	x		x	x	x	x	x	x		x			x	x							x	x			x			x
2.	Colorado						x																			x																	
3.	Connecticut			x			x	x			x			x		x		x			x		x			x	x			x			x									
4.	Florida- A&M																																										
5.	Florida-State U.	x		x			x	x			x				x			x								x		x	x		x		x		x		x					x
6.	Florida-U of Miami																																										
7.	Georgia	x		x		x	x				x				x			x			x	x				x		x									x					x
8.	Hawaii						x																																				
9.	Indiana - Purdue							x								x		x			x					x							x	x									
10.	Kansas	x			x			x							x	x		x						x		x									x	x						x	
11.	Kentucky																									x																	
12.	Louisiana																									x																	
13.	Mich.-East M.U.						x	x								x					x					x									x								x
14.	Mich.-Ferris State	x					x									x					x					x									x								x
15.	Mich.-Wayne State		x		x	x	x						x	x	x	x					x			x											x				x	x		x	
16.	Nebraska																									x																	
17.	New York		x		x		x	x			x					x		x			x		x			x		x					x		x				x				x
18.	Ohio						x									x		x	x							x									x		x						
19.	Oregon					x	x		x	x	x															x																x		
20.	South Dakota					x	x	x							x						x					x																	
21.	Tennessee	x				x	x				x		x	x		x		x			x					x		x								x				x		x	
22.	Texas				x			x								x		x								x									x	x	x						
23.	North Carolina*	x					x					x						x			x					x										x								
24.	Illinois U. **	x					x					x						x			x					x										x								
	Totals	8	3	3	5	6	16	9	1	1	7	2	3	4	5	11	1	12	2	2	11	1	3	2	-	20	1	4	1	1	1	1	4	-	10	6	5	1	3	2	3	1	8

* Research Project transferred from North Carolina to Illinois

** California has prepared many subtests in certain occupations which are not listed here.

III. DUPLICATION OF EFFORT IN TEST DEVELOPMENT

Much of the work that has been done in the evaluation of occupational proficiency tests (outside the armed services) has been restricted by lack of adequate resources. Adequate funds have not been available to employ professionally qualified personnel to work on the construction of the tests full time or (even more importantly) on the analysis of these instruments to insure their reliability and validity. The same applies to the preparation, duplication, administration of available tests, and the analysis of the results.

A. Pioneering Efforts of Trade and Industrial Education Leaders

The tremendous work in test development and administration of the former Bureau of Industrial Teacher Training and Vocational Curriculum Development of the New York State Education Department; the significant number of occupational competency tests and programs of the California State Education Department; the trade and industrial teacher testing program of the Pennsylvania Department of Public Education; and the pioneering work with subtests of the Division of Adult and Vocational Education of Florida State University, as well as the accomplishment of a few other states and universities, stands as a tribute to what a small dedicated group of men with minimal resources can accomplish. In spite of these singular contributions, every person, who has developed or administered such examinations, together with local, state, and national vocational industrial-technical education, administrators, has expressed increasing concern for more reliable measures to evaluate the occupational competency of prospective trade and industrial technical education teachers.

Thus, this project reflects a significant breakthrough...a long sought nationally coordinated effort to establish the current status, identify practical methodology acceptable to the states, develop and pilot test at least two major examinations on a national base, and then establish the feasibility of collectively pooling talent and resources through a cooperative consortium of states arrangement.

While it was generally known that several states were using occupational competency tests, the survey of existing practices has revealed that presently about the same number of states use tests as reported by Schaefer. In a number of instances, several centers within a state are engaged in test development.

A simple summary of thirteen (13) occupational competency tests on which a number of states have concentrated their efforts, independently, with exceedingly limited (if any) coordination, is reported in Table IV. As stated earlier, if all the states had reported, the researchers know that each of the numbers would be increased.

Table IV - Multiple Institution Activity Developing Occupational Competency Tests for the Same Trades	
Trade Area of Occupational Competency Tests	Number of Institutions Preparing Similar Tests
Machine "Shop"	20
Automotive Mechanics	15
Electrical Construction	12
Electronics	10
Printing	10
Carpentry	9
Drafting	9
Air Conditioning	8
Welding	8
Cosmetology	6
Auto Body Repair	5
Diesel Mechanics	5
Sheet Metal Work	5

B. The Use of Oral Testing Practices

Most responses to the survey inquiry reported the use of written tests for evaluating trade proficiency. Some states also employed practical performance tests. Oral tests are still used by some states; others have discontinued them. Some of the oral tests were formal, containing structured patterns and predetermined questions intended for the candidate to supply information on his knowledge of trade information and trade practices. Other, more informal, oral interviews were designed primarily to assess a candidate's ability to express himself, his general bearing in a face-to-face relationship, and his occupational and educational background.

A small number of tests, included in Table IV, reflect regional needs and requirements. However, most of the tests are in trade areas which are little, if at all, affected by geographic or regional characteristics in skill, technique or special trade knowledge. This is to say, Ford, Chrysler or General Motors automobiles must be serviced the same way in Texas, New York or Maine. A machinist may work on different products in different states, yet he performs milling machine, lathe or grinder operations in the same manner, no matter where the equipment is located. Likewise, a radio set, a television set, amplification equipment or the various electronic devices found in radio or television stations require the same kind of service regardless of their geographic or regional location.

Yet, the tabulation shows that for the machine trades, tests have been prepared in twenty different institutions located in nearly all sections of the country. For the automobile repair and service

occupations, fifteen tests have been prepared; for electrical installation, twelve; printing, ten; drafting, ten; and electronics, ten.

Studies to validate the tests and establish their reliability have been undertaken by only three states. Lack of funds and staff with experience have restricted further efforts to carry this work to the level where the resulting instruments would provide objecive and reliable evidence for the evaluation of occupational competence.

The important question then is: "What results might have been achieved if all twenty institutions, who developed a machine trades competency examination, had supported a single effort of test construction and pooled their knowledge and experiences to validate the results and assess how such instruments and the process of test development and administration might become more effective and efficient". The same inquiry would relate to all other trade areas where a number of institutions developed tests for the same occupations.

Resources must be found to bring to bear on the whole process of occupational competency test development, particularly test development on the highest level possible of psychometric skill and theory. Such a concentration of practical test development is not likely to occur, as long as various states continue to work independently on the problem. A coordinated research and development effort in which many states pool their resources would help to eliminate wasteful duplication, release important testing personnel for essential test development services and provide support for creative new approaches.

Further support for such concentration of effort is provided by a content analysis of the available tests. The machine occupation and electronic test samples were analyzed as to the currency of test content, range of items, types and distribution of items, clarity of items, practicality and comprehensiveness and evaluated as poor, average, excellent.

IV. ANALYSES OF AVAILABLE TESTS IN SELECTED TRADE AREAS

The written (theory) and performance (industrial practices within the trade) intended to cover essentially the same body of content. However, even a casual check of the tests revealed a wide disparity of range in the selection and the number of items for a particular phase of the occupation. Thus, it became necessary to make a more careful analysis of the available tests in two major occupational areas.

A. Machine Industries Occupations (Machine Trades)

As indicated earlier, states using occupational competency tests may apply them in different combinations to various purposes,

Whichever combination of purposes are selected, the ultimate objective is to establish evidence of an individual's occupational competence. Since no descriptive information or statistical data has been made public by the various test developing agencies, a review committee of test and subject specialists was appointed for the purpose of assessing a number of written and performance tests in the same trade area.

The major elements used as criteria in the assessment of each written test appear in the left half of Table V. Those that apply to a performance in simulating industrial conditions and practices are indicated in the right-hand portion. The information reported on these forms, as had been indicated in the transmittal letter, will be treated as confidential and no state, or a particular state examination, will be identified. The comments made under the column "Value to Project" were those of the project staff primarily. The intent was to avoid duplication of effort by later using appropriate, effective and well prepared test items and techniques in developing the pilot tests.

Table V - Summary of Evaluation of Machine Trades
Written and Performance Occupational Competency Tests

Written Test (A)					Performance Test (B)				
Factors Considered	*E	A	P	Value to Project	Factors Considered	*E	A	P	Value to Project
Test Content (Currency)	2	4	6		Test Content (Currency)	1	2	2	
Range of Items	2	5	5		Practicality	-	3	3	
Types of Items	1	5	6		Comprehensiveness	-	3	2	
Distribution of Items	3	4	5		Skills Measurement	-	2	3	
Clarity of Items	2	3	7		Judgment Measurement	-	2	3	
Trade Judgment	2	2	8		Trade Diagnosis	-	2	3	
Practicality	2	2	8		Speed Measurement	-	3	2	
Comprehensiveness	1	3	8		Procedures Planning	-	3	2	

Approx. % Objective _____
Essay _____

*E-Excellence
A-Average
P-Poor

B. Machines Industries Occupation (Machine Trades) - Written Test

There was an exceedingly high degree of agreement amont the test evaluators as represented by the single composite number indicating the evaluation of a test for each evaluation item. No one test was judged to be excellent in all categories or all poor in all categories. The ratings, while representing a subjective judgement, are those of persons who are experienced in all aspects of occupational competency test development, administration, and evaluation.

TABLE VI

TEST CONTENT ANALYSIS BY SUBTRADE AREAS OF WRITTEN TESTS FOR MACHINE TRADES

Main Divisions	Tests / Type Test Items	A			B			C			D			E			F			G			H			I			J			K			L		
		MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E	MC	T/F	E
Bench Work		24	11		7	4		10	31		11			25			19	9	C 9		2		10			8			15						3		
Machine Sawing/Filing																	8									3			3								
Drill Press Work		13	1		6	3		9	10		9			12	2		10		ShA 13		9		8			7			9			22			7		
Grinding Processes		34	6		3	4		1	2		7			30	10		12				9		10			10			8			27			1		
Heat Treatment						2								30			11						5			6			4			14					
Inspection Practices										PI 15							13						5			4						13					
Lathe Work		78			4	1		16	31		21			53	8		37	18			26		20			23			18			55			19		
Milling Processes		26	12		4	8		13	8		18			41			26	9	C 4			7	10			15			14			30			5		
Numerical Control						2													ShA 16																		
Shaping Processes		24	6			1		1	2					25			13					4													5		
Blueprint Reading								12															5												32		
Handbook Use								12																					2								
Metals						2		11															8			4			6								
Trade Theory			6		11	21		36	44		6			37	12						15	15	12			14			18						17		
Trade Science																																26			16		
Trade Calculations											12												15			6			4			35			17		
Totals of Test Items by Test		199	42		35	48		121	128	15	84			253	32		149	36	42		72	15	108			100			101			222			122		

Code-Types of Questions: MC=Miltiple Choice T/F-True-False PI=Picture Identifications ShA=Short Answer
E=Essay

The distribution of the ratings indicates the need for more effective and reliable measuring devices and information to appraise a test. In the absence of statistical or empirical data, the committee determined the distribution of the test items among the various major divisions within the occupation and related trade areas.

These major divisions within the machine trades and the related areas of technical knowledge dealing with blueprint reading, trade science and mathematics, etc., for which test items appeared in the tests that were evaluated, are reported in Table VI under these major divisions. The major divisions are referred to in some states as sub-areas.

It should be noted that all but one of the tests used multiple choice type test items. Five tests contain only multiple choice test items. Four tests use multiple choice and true and false test items. One test utilized multiple choice, true-false, completion, and short answer types of test items. One test contained true-false and essay type items. The grouping of test items, according to the trade content areas they were to measure, revealed startling variations:

1. Only two of the written tests included blueprint reading.

2. Three tests attempted to measure competency in the theory of machine sawing and filing operations.

3. Seven tests included items on industrial practices as experienced in the trade.

4. Two tests include problems requiring the use of handbooks as experienced in the trade.

5. Two tests contained problems and processes relating to numerical control or instrumentation applications in the trade.

Within the structure of each of the tests, there was a tremendous disparagement in the range and number of test items. While all tests included items relating to bench work, turning operations, drilling and drill press operations, grinding practices, and milling machine processes, the wide variation in number of test items purported to measure occupational competency, are summarized in Table VII.

Table VII - Disparity in Number of Test Items in Major Divisions Covered in all Tests

Major Divisions of the Trade	Variations in Number of Test Items
Bench and Assembly Work	2 to 25
Drilling Machines and Processes	6 to 22
Turning Machines and Processes (Lathe Work)	4 to 78
Grinding Machines and Processes	3 to 34
Milling Machines and Processes	4 to 26

The sum total of the multiple choice test items ranged from 65 on the test with the lowest number to 253 on the test with the highest number.

No effort was made to evaluate the quality of the test items. The test item tabulation merely shows a great lack of consistence in establishing which major divisions of the machine trades are most typical and representative of the occupational competence of the journeymen working in the machine industries. At first, it was thought that the difference in content was the result of geographic characteristics, variation in products of the industry, and differences in training programs. A further inquiry proved this not to be true.

The picture was made more confusing (even contradictory) when a review was made of a number of trade analyses. Made by machine trades teacher candidates in trades and industries teacher training programs in different regions of the country, and with widely differing experiences, the trade analyses showed a great consistency to the occupational content which each individual reported as representative of the competencies a journeyman in the machine industries should possess.

C. Machine Industries Occupations (Machine Trades) Performance Tests

The criteria for evaluating the performance tests were earlier identified as appearing in Table V. As implied, the performance tests concentrate on the day-to-day work skills and directly applied technology which a journeyman tradesman performs. The tests, therefore, should measure such characteristics as skill, speed, accuracy, safe work habits, trade judgement, diagnosis capability and those other factors which identify a competent journeyman tradesman.

Only five tests were readily available for analysis. Note that only one of the performance tests was judged to be excellent in only one factor; namely, currency of content.

An analysis of the trade operations essential to complete the test work piece(s), as well as a study of the machines, tools and equipment on which trade skills were to be measured showed a heavy concentration on turning processes and lathe work. One test involved producing several short work pieces; one, requiring operations, drilling and other bench work, drill press processes, surface grinding and simple milling machine work and operations. Another consisted of turning, milling and universal grinder operations. The other performance tests concentrated on turning processes and engine lathe work, simple milling operations, and elementary layout work--usually requiring the making of one more work piece(s).

There is no evidence available which would indicate that occupational competence in the machine trades can be measured by acceptable performance on turning and milling processes and machines, bench work and assembly operations. Quite the reverse is indicated by trade analyses, job specifications and the demands of journeymen craftsmen in the machine trades. In addition, the machine trades teacher must be capable of teaching industrial processes for the full range of machine tools, heat treatment, and bench and inspection

practices which are common to the trade. The level of teaching ranges, from classes of beginners, preparing to enter the machine trades as advanced learners/apprentices or technicians, to special groups of journeymen craftsmen who return periodically to the schools for occupational extension work to upgrade their skills and technical competencies.

This analysis of written and performance tests for the machine trades indicates severe limitations in test development, and the need for more concentrated, coordinated effort, a broader base for the test items, and greater specialized test development competence. These are necessary to develop tests that are relevant to current industrial practices, have acceptable accuracy, validity and reliability, and can be utilized by a consortium of states interested in a cooperative endeavor.

D. Electronic Industries Occupations (Electronics - Communication) Tests

The same factors were applied by another selected committee for electronic communications. The committee assessed seven (7) written tests that were submitted and four (4) practical tests. The results of this assessment are summarized in Table VIII.

Table VIII - Summary of Evaluation of Electronic Communications Written and Performance Occupational Competency Tests

Written Test (A)					Performance Test (B)				
Factors Considered	*E	A	P	Value to Project	Factors Considered	*E	A	P	Value to project
Test Content (currency)	1	4	2		Test Content (currency)	1	2	1	
Range of Items	3	3	1		Practicality	1	2	1	
Types of Items	2	5			Comprehensiveness	-	3	1	
Distribution of Items	1	5	1		Skills Measurement	-	3	1	
Clarity of Items	2	4	1		Judgment Measurement	1	3		
Trade Judgment	1	3	3		Trade Diagnosis	1	3		
Practicality	2	3	2		Speed Measurement		3	1	
Comprehensiveness	2	3	2		Procedures Planning		3	1	

Approx. %

Objective _____

Essay _____

* E - Excellence
A - Average
P - Poor

Table IX

TEST CONTENT ANALYSIS BY SUBTRADE AREAS OF WRITTEN TESTS FOR ELECTRONIC-COMMUNICATION

TEST A		TEST B		TEST C		TEST D	
Main Divisions or Sub-Trade Test Areas	No. of Test MC Items	Main Divisions or Sub-Trade Test Areas	No. of Test MC Items	Main Divisions or Sub-Trade Test Areas	No. of Test MC Items	Main Divisions or Sub-Trade Test Areas	No. of Test MC Items
Fundamental Concepts	29	Basic Electronics	10	Fundamental Principles	15	Electronic Theory	20
Batteries	9	Measuring Standards, Tolerances	5	Power Source	5	Electronic Components	10
Circuits	23	Conduction	2	A.M. Receivers	10	AM-FM Receivers Trouble Shooting	10
Test & Measurement Equipment	16	Magnetism	2	F.M. Receivers	10	Circuits	15
Power Source and Motors	26	AC Electricity	5	Radio Station Operation	10	TV-Components Trouble Shooting	10
Transmission	18	Single Phase Circuits	13	Public Address Systems	8	Theory of Sound Transmission	18
Vacuum Tubes	20	Transformers	2	TV Receivers	15	Radio Studio	15
Circuit Components	20	Batteries	1	TV Station	10	TV Studio	15
Rectifier, Amplifier Oscillator	57	Electronic Theory	5	Trade Practices	8	Miscellaneous	5
Modulation Radar	12	Electronic Devices	12				
Computer-TV Receiving	126	Basic Circuitry	31				
Industrial Electronics	13	Cascade Amplifiers	8				
		Miscellaneous	4				
Totals of Test Items by Tests	Test A 275		Test B 110		Test C 91		Test D 118

Again, no one test was judged to be either excellent or poor, as a whole. Some categories received a grading of excellent; other sections were judged average or poor. These ratings, again, indicate a substantial degree of inconsistency in test development and administration, and the need for joint national effort to inspire all aspects of occupational competency testing.

E. Electronics Industries Occupations (Electronics-Communications) Written Tests

On the written test, all test items were phrased in a combination of multiple choice patterns. A casual glance at Table IX, which tabulates the subdivisions from which test items were derived, shows substantial difference in concept and judgement as to what constitutes occupational competence. The content of one test bore close resemblance to textbook outlines, whereas two of the others were developed around equipment commonly used in the trade and in studios. The number of test items on these tests ranged from ninety-one (91) to two hundred and seventy-five (275). No evidence is available which supports that one test is better than another. Also, there is no information based on test experience as to how many, and what kinds of test items, constitute a valid, reliable test.

All tests contained a section on "Basic" information. The test items listed under fundamental concepts, basic electricity, fundamental principles and electronic theory, dealt with information most often found in high school or two-year institute textbooks on physics and science. There were few test items relating principles to applications performed by the craftsman/technician in the occupational world.

For tests intended to measure occupational competence in an occupation in which geographic or regional differences plan an insignificant part, the variation of categories in the tests is amazing and seems to reflect the biases and preferences of the item writers to use a textbook, theoretical approach, even to the point of dealing with academic sciences, rather than the results of a thorough analysis of a cluster of jobs in the electronics communication field. A comparison of the test content with trade analyses made by teacher candidates in trade and industrial/technical teacher education programs, with diverse experience backgrounds, showed much stronger consistency as to what constitutes journeyman competence among the analyses than among the tests.

F. Electronics Industries Occupations Performance Tests

The performance tests concentrate on "troubleshooting" under simulated conditions. Defects and faults are introduced into certain pieces of equipment which the examinee must correct. This approach is representative of the work in the field. Referring back to Table VIII, note that no test was judged excellent or poor in its entirely. There was a greater common core, or uniformity of subtrade test areas, among the electronic communications performance tests than for the machine trade tests. The evaluation of the electronic communications practical

tests concentrated upon procedures and methods rather than entirely upon the finished product. No supportive data for test evaluation was available to the project.

The end results or products produced through the test, although limited in number, give strong support to the need for much more concentrated effort in test development. All evidence points to needs within state departments of education, and trade and industrial teacher education institutions for sufficient funds and adequate professional and support staff, facilities, and equipment to carry on all facets of occupational competency testing. The planning, test development, administration, evaluation and research necessary for establishing of validity and reliability across a wide base of national testing can not be done under existing conditions. The reporting, and tabulating of results necessary to establish valid national standards, which the states may apply to their special needs, require broad support.

V. OBSERVATION RATINGS, ORAL TESTING AND TESTING TIME

A. Observation Ratings of Work Skills and Habits in Performing Examinations

For the performance tests, the emphasis was primarily on real live situations with the finished product the measure of a candidate's occupational competency. However, it was recognized that the work skills and processes in achieving a finished product are important factors in the overall proficiency appraisal. A number of states, therefore, included factors to be observed while the candidate was at work.

This personal observation by a trades examiner introduces a number of variables in the performance evaluation. While it is relatively easier to establish criteria for written tests, the observation of work habits, work attitudes, workmanship, safe practices, etc. involve subjective judgements which affect the reliability of performance tests. In two tests, several specific items were listed with a range of point values assigned to each judgement. The finished product evaluation involved accuracy and completion of a number of steps within time limits. A graduated range of credits was assigned to record superior accuracy and completion in shorter time when the candidate performed less satisfactorily in terms of quality, accuracy and time requirements.

B. Time Allotment for Conducting Examinations

With very few exceptions, the written tests were objective in structure. Multiple choice and true-false items constituted the major part of written examinations. In some instances, completion and short-answer essay-type test items were included. The reported time span for written examinations ranged from two to four hours. For the performance tests, a longer period, ranging from four to eight hours, was needed. No time limit was indicated in those instances where the oral test, or interview, was given. Kazanas and Kief have reported time spans for oral

and interview tests from one-half hour to two hours. Based on observation and comments by individuals who relate to the interviewing and selecting of trade teachers, a general estimate of one hour for the oral part provides sufficient time to establish a candidate's background and to make other subjective judgements.

VI. RESTATEMENT OF PURPOSES OF OCCUPATIONAL COMPETENCY TESTS

Earlier, it was stated that occupational competency tests are used to: establish a teacher candidate's degree of occupational proficiency; meet certification requirements, fulfill one of the requirements for entrance into trade and industrial/technical teacher education programs and instill others to serve as a determining factor for earning college credit in undergraduate or graduate degree programs.

Summarizing what local and state administrators and trades and industries teacher educators have reported, occupational competency test results are utilized for part, or all, of these purposes:

1. As a regular means for certification,
2. As a requirement for probationary appointment,
3. As a prerequisite for admission to preemployment industrial teacher education programs,
4. As a basis for granting college credit in a content (specialization) area,
5. For prognostic and diagnostic purposes to establish weak or deficient content areas which the candidate needs to correct or improve, and
6. As fulfilling one of several requirements for certification.

VII. TEST WRITERS AND COMMITTEES INVOLVED IN OCCUPATIONAL COMPETENCY TEST PREPARATION

Practically all of the occupational competency tests are the result of committee effort. The composition and the backgrounds of groups developing occupational competency tests, as reported, include the following combinations:

1. Competent teachers in the specific trade or industrial occupation;
2. Selected occupational specialists from industry working with teachers;

3. State trade and industries education supervisory staff;

4. Trade and industries teachers and state officials;

5. State department test development personnel, trade and industrial/technical teacher educators, and/or state trades and industries supervisors;

6. Industrial teacher educators and occupational specialists from industry;

7. Qualified teachers and specialists from industry, supervised by state department and industrial teacher educational personnel with the assistance of joint advisory committee members;

8. Teacher educators, qualified vocational teachers and specialists from industry.

Variations in the composition of the groups involved in developing the tests naturally affect the nature and administration of the evaluative instruments and influence their quality.

VIII. STATE PRACTICES IN TEST ADMINISTRATION AND EVALUATION

A. Administration of Occupational Competency Tests

Reports submitted by the states and teacher education institutions reveal that competency examinations are administered by:

1. Trades and industries teacher education personnel working in institutions,

2. Trades and industries state supervisors from state education departments,

3. Testing supervisor (reported by one state).

Three industrial cities have assigned the responsibility of evaluating the competency of trade and industrial/technical teachers to a special board of examiners.

B. Evaluation of Test Results

Another serious problem in establishing uniform, valid practices for measuring occupational competency is represented by the manner of grading the tests and the individuals who carry out this responsibility.

The objective types or parts of test are graded by:

1. Secretary in the office of supervisor or trades and industries,
2. The same persons who constructed the test,
3. A teacher who administered the examination,
4. State trade and industries supervisory staff,
5. Trades and industries teacher educators,
6. Qualified proctors specially engaged to administer and grade the examinations.

Several states reported using data processing for the grading process and for reporting written test results. Other institutions are presently engaged in trying to establish data processing procedures for reporting the results of performance tests.

IX. DATA PROCESSING CONSIDERATIONS

It should be noted in this connection that the project staff has been charged by the Planning Committee and Principal Investigators to utilize data processing. Thus, consideration is being given to techniques in test development, measurement analysis which may be computerized into a test bank storage, retrieval, and distribution system.

When functional, such a system will be applicable and available to every participating organization in the Consortium of States, and ensures accuracy of results, more efficient use of test development and measurement personnel, and greater efficiency in making print-outs of results for diagnostic and other purposes.

X. VALIDITY AND RELIABILITY OF THE TESTS

The validity and reliability facets of the study, unfortunately, must be reported with some brevity. The evidence is crystal clear. The surface of need for establishing validity and reliability for occupational competency tests in the trades and industries has been barely scratched. This fact will later be borne out and reemphasized as a condition existing in testing programs of other groups representing military establishments, industries and labor organizations. The experiences of private educational testing and psychological testing services is identical.

Two states reported ground-breaking work in establishing validity and reliability of occupational competency tests through studies utilizing available data. No other information has been found in the literature to support further efforts in this area. However, a number

of tests have been subjected to such statistical treatment as: item analysis, difficulty of items, etc. In general, face and internal validity of tests was based on "the authority of the expert". The authorities were experienced tradesmen, teachers, teacher educators, state supervisors all of whom had been involved in analyses and development. Other bases were found in appropriate texts and other technical publications.

The obvious fact is that occupational competency examinations, in the trades and industries, have not generally been constructed and the results validated or standardized according to acceptable procedures of test evaluation.

XI. CONSTRAINTS TO A COORDINATED OCCUPATIONAL COMPETENCY TESTING ~~REPORT~~ EFFORT

It should be reported that only adaptations of known procedures and techniques for test planning, development measurement, evaluation or reporting have been uncovered in this survey. Analyses of the tests used by the military, industry, labor, testing services and others, reveal practices that have been used over the years by occupational competency test development persons in trade and industrial/technical education. Trades and industries educators have been recognized for their extensive knowledge and practical expertise in making trade and occupational analyses, utilizing most forms and kinds of test items in constructing theory and performance tests, and have the capability and working knowledge to adapt tests to computerized procedures. All of what has been uncovered has been utilized by the trades and industries educator in one form or another.

The central issues focus on seven (7) major forces that constrain these professional educators from making a broad base and an in-depth approach to the problem. Although, there are other constraints, the survey identifies seven (7) restrictions which vitally affect the process and product of occupational competency testing for the trades and industries:

1. Lack of permanent positions in test development and measurement, with little encouragement towards a full-time career in this program,

2. Limitations of financial resources and full-time personnel to select, coordinate and organize committees.

3. Scarcity of qualified researchers and testing specialists with adequate time to actually develop good examinations and follow through on their analyses to establish reliability and validity.

4. Lack of vehicle to cooperatively administer the tests, and conduct other essential evaluation functions,

5. Lack of a central physical facility and limited personnel for conducting continuous validation and reliability procedures required to truly make tests objective instruments for competency evaluation,

6. Restricted geographic bases and essential national test population to establish appropriate norms,

7. Limited coordination of test development even in states where two or three organizations are engaged in such work.

The early efforts of test construction and administration, which had been made under discouraging circumstances and conditions, still prevail today when this nation is at its highest point in industrial development and technology. This in-depth review of the state-of-the-art has shown much duplication of effort and concentration on test development for a limited number of trades. It has, also, revealed a lack of supportive statistical data upon which the accuracy, validity and reliability of a test may be established.

It is, therefore, not surprising that a number of dedicated individuals, in a number of states, who are concerned with the professional improvement of teachers in vocational education are urging a national coordination of occupational competency testing effort. The program should be of sufficient scope and flexibility to meet the special needs of all the states on a voluntary basis, and should produce valid and reliable instruments through which it is possible to establish standards and norms of occupational competence, and to qualitatively affect the total services provided through vocational education.

PART FOUR

OCCUPATIONAL TESTING MATERIALS AND PROGRAMS OF INDUSTRY, LABOR AND GOVERNMENTAL ORGANIZATIONS

I. SURVEY OF OCCUPATIONAL COMPETENCY TESTING PROGRAMS OF INDUSTRY

A. Sources of Industrial Contacts

Future teachers of trade, industrial and technical subjects acquire and develop their skills in industry. The placement of individuals with skills and know-how appropriate and adequate to meet the requirements of a particular job in industry has become an economic necessity. It seemed, therefore, highly desirable for the project staff to investigate the methods and procedures employed by industrial firms for the evaluation of occupational competency to see whether similar procedures would be applicable to the evaluation of the same competency essential for teaching in vocational programs.

The research team was faced with a difficult task. From among the many thousands of industrial establishments, it was necessary to determine which companies do engage in formal performance testing and the industries in which they are located.

The review of the published literature revealed no printed studies whatever on performance testing. Assistance was sought from the American Management Association, The National Association of Manufacturers, the Industrial Conference Board, American Association of Industrial Management, National Metal Trades Association, Associated Electrical Industries, National Tool, Die and Precision Machining Association and the National Association of Industrial Training Directors

The National Association of Manufacturers opened their files to the research staff and a list of companies was compiled from various industries, who conduct some form of personnel evaluation through tests. It was, also, possible to obtain the names of individuals engaged in employee testing and personnel research. A mailed inquiry was sent to thirty-five (35) companies soliciting similar information as had been requested from each of the states.

These companies were contacted by mail. The response was rather disappointing; of the thirty-five (35), there were twenty (20) respondents; of the twenty (20) companies, two (2) carried on a program of occupational competency testing. The remaining eighteen (18) replies were negative, indicating no formal competence tests were administered. The responses indicated that occupational competency evaluation for upgrading, or for salary or wage classification, is largely the responsibility of the immediate supervisor whose judgement, based on the day-to-day job performance observation, is accepted as valid evidence of an individual's competence. Of special interest to the project were the two companies which do carry on occupational proficiency testing. One company administers a written proficiency examination. The examination content is derived from an analysis of the various job descriptions

which are part of the employee-management contract. No efforts have been made to carry on statistical treatment of the test results. The other company is carrying on simulated performance tests based on a thorough analysis of the tasks in a particular job. Other forms of tests are presently in the development stage. The American Management Association recommends a personal appraisal form to its members which includes personality characteristics as well as a rating scale of job performance.

B. Uses of Tests by Industry

A review of several studies published by the National Industrial Conference Board [26] show that tests are used in industry for determining:

Mental ability (Intelligence)
Mechanical ability or aptitude
Interest inventories of employees relate to measures of personality

No evidence was presented that any of the three hundred eighty-four (384) firms responding to the National Industrial Conference Board's questionnaire relating to occupational competency testing carried on any form of practical performance testing. The tests the companies were using applied to white and blue collar workers. Interest and personality evaluations were used to a much larger degree with white collar workers; mechanical aptitude and mechanical ability tests, with blue collar workers.

Stated briefly, tests are being used for predictive purposes rather than for the evaluation of an individual's job proficiency. It is, therefore, not surprising that most test applications in industry are for selection and placement at the time of beginning employment. Approximately, 10% of the firms surveyed utilized tests for counseling. Among the nearly four hundred (400) companies using one or more tests, sixty-five percent (65%) use commercially available tests. Of the companies with over one thousand (1000) employees, seventy-nine percent (79%) use these commercial tests. Those companies with less than one thousand (1000) employees, fifty-three percent (53%). In addition, nineteen percent (19%) of the total companies included in the NICB survey apply commercially available tests for white collar employees only; five percent (5%) for blue collar employees only.

Twenty-six percent (26%) of the companies, employing one or more tests, use their own tests (or those developed through cooperation with a trade association) for both blue collar and white collar employees. Such tests are used by seven percent (7%) of the companies for white collar employees only; seven percent (7%) for blue collar employees only.

C. Personnel Responsible for Industrial Testing Materials and Programs

Of interest to the project staff were the background and training of the individuals in charge of industrial testing programs. A breakdown of the job classifications of such persons or agencies for two hundred thirty (230) manufacturing and non-manufacturing industries is reported in Table X.

Table X - Job Classifications of Personnel Responsible for Industrial Testing Programs

	Job Classification or Testing Agency	Nature of Industry	
		Manufacturing	Non-Manufacturing
1	Company employee with training in psychology	59	75
2	Company employee who is a qualified psychologist	9	6
3	Director or supervisor of personnel	5	16
4	Not specified	12	24
5	Outside testing service	15	9
	Totals	100	130

D. Observations on Limited Industrial Proficiency Testing

There are many reasons why there is so little work published or, in fact, actually done in occupational competency testing in industry. Possibly, industry believes it satisfactory and has found it expedient to follow the practice of closely observing the performance of new employees during their beginning days of employment as the equivalent to a performance test. In the absence of standardized, valid instruments, which may be secured commercially, many medium and small-sized companies have stated that lack of qualified competent personnel, and the cost of developing accurate and reliable instruments, makes the operation of a performance testing program prohibitive. Whether action to not carry on an occupational training program is justified on such grounds is a decision industry must make.

However, the project staff who have spent their industrial and professional lives working in and with industries, in expressing their personal beliefs, feel that valid occupational competency programs should be widely established across all industries, in the labor movement and throughout government agencies.

The investment by industry in such programs would pay great dividends in human satisfaction and in increased productivity. Certainly, the high cost of limited productivity of the untrained or untrainable; the man hours lost through underemployment; the failure to recognize occupational skills and technology developed within quality programs of vocational education by employing tested graduates as advanced learners, are just a few of the reasons why industry should assess and expand its efforts in occupational competency testing. The most critical occupational sector of the economy relates to the blue collar craftsmen and technicians in the skilled trades and industrial/technical occupations.

II. SURVEY OF OCCUPATIONAL COMPETENCY PROGRAMS OF CIVIL SERVICE AND OTHER GOVERNMENTAL AGENCIES

A. Changing Concepts of Competency Testing

Government agencies, as well as any other organizations employing people for jobs which require a wide range of skills and considerable training, are vitally concerned with the selection of the individual with the appropriate occupational competency for the right job. Civil Service agencies, on national, state and local levels, charged with the selection of personnel for the multitude of jobs found at all employment levels, have employed examinations in various ways over a period of many years. Most Civil Service examinations are, however, of the paper and pencil variety and cover primarily the job knowledge, job information and job judgements essential to carry on the work of a particular job classification.

For many years, it was believed that there was a high degree of correlation between occupational information and job performance involving manipulative skills that a command of the theory could serve as an indirect measure of skill competency. Many experiences gained during World War II, with assessing shop skill performance, disprove this theory. The research conducted by Stuitt, in appropriately weighing the relationship between job performance and tested job knowledge, in the final competency evaluation proved that written tests of occupational knowledge are not dependable or good measures for the evaluation of shop skills. An accurate assessment of an individual's occupational competency can not be made without some type of direct or indirect performance measure (Shimberg)[27]. These same conclusions were reaffirmed last year in an earlier reported study of Koenigsberg and Reilly.

In recent years, the evaluation of individuals for jobs, requiring a degree of skill in office occupations, have included performance tests. These office and business occupations tests have been standardized and are frequently used to measure several levels or job clusters of job classifications.

In those trades and industries occupational areas where manipulative skills are the basic requirement for job, performance tests are part of the overall evaluation of an applicant's qualifications. Automotive maintenance, building maintenance, machine occupations and

electrical occupations are typical of those areas requiring performance tests.

B. Construction of Civil Service Tests

A staff of test specialists determines the scope and content of the examinations from a job analysis, based on the specifications furnished by supervisors of the departments in which positions must be filled and from other experts in the field. Emphasis in the performance examination is placed on the practical requirements of the job. Some statistical effort is made to establish validity and reliability through item analysis, pretesting of questions, measures of central tendencies, means, standardization, and others. However, limitations of personnel, the great numbers of examinations which have to be prepared place heavy reliance upon face validity and internal validity, and support by the authority of the expert. With the availability of computer facilities, it is hoped that more effective efforts can be made in standardizing performance tests, in establishing norms and pursuing validity and reliability studies.

Passing grades are emperically established and are influenced by the supply and demands of the labor market. Attempts have been made to establish a bank of test items. Here, again, limitations of personnel and funds make it difficult to keep the test item pool up to date. For those occupational areas where the permanent testing staff lacks the expertise to develop examination items, outside experts are engaged to provide the necessary examination content.

C. Administration of Performance Tests

The problems encountered in the administration of performance tests by Civil Service Departments are similar to those of all other organizations engaged in occupational testing. For instance, in New York State, the examinations are given in selected centers which lend themselves to the conduct of the tests in a realistic and practical setting--area garages and repair centers, shops, and laboratories typical of the work situations. Occasionally, the shops of vocational education centers or technical institutes are used. Frequently, the supervisors of the departments act as examiners. Specific directions for evaluating the applicant's performance are issued and examination results are reported by each examiner independently in writing.

Special care is exercised to maintain examination security for those tests which must be given in different locations at different times. Selecting and instructing examiners is a common problem.

D. Observations on the Adequacy of Civil Service and Other Government Testing Programs

Contact with various bureaus of the Civil Service at the federal, state and local level involved in test development and administration reveals a similar approach to the problem of occupational competency testing used by industry. Much of the testing is still in the form

of written tests. However, there is increasing recognition that jobs involving a high level of skill require performance tests to extablish an applicant's occupational competency.

Efforts are being made to develop such tests on a more objective basis. Limitations of personnel and funds and the tremendous range and number of positions for which examinations must be prepared have slowed the development of performance tests. Lack of proper facilities, the limited number of applicants for a single trade examination, the need for conducting these examinations in various geographic locations within a state or throughout the nation, places added restrictions upon performance test development and administration.

In larger metropolitan areas, where there are heavy demands in certain fields, test centers have been established and are functioning within certain limits. The concensus of the individuals contacted, regarding the value of presently administered performance test, ranges from acceptance of existing practices ("....the tests do the job for us... they are practical and we have few challenges....") to recognition that a great deal of research is necessary to develop accurate, valid and reliable instruments. Surprisingly, little information concerning performance testing has been published for the vast number of Civil Service testing programs.

III. SURVEY OF OCCUPATIONAL TESTING PROGRAMS OF MANPOWER DEVELOPMENT AGENCIES

The search for occupational competency testing included agencies and organizations involved in manpower training and development, various state and local employment agencies and private institutions. No information was available on any form of occupational performance testing. State and local employment services, at times, employ tests concerned with mechanical aptitude and comprehension, manual dexterity, spatial visualization, mechanical and abstract reasoning, intelligence and other factors. These are utilized for predictive purposes.

Some tests involve peg boards, tweezers, assembly of simple parts or blocks, and the like. Most tests are of the paper and pencil type. Perhaps, in the manpower field with its emphasis on training and development, there is greater urgency for determining potential tather than to establish instruments for evaluating occupational proficiency.

There is little doubt, however, that the increasing complexity in the skilled occupations and the risk involved in placing less than competent workmen in these occupations will eventually require some form of performance evaluation. Prediction of potential success is significant; evaluation of competence is equally, if not more important.

IV. SURVEY OF OCCUPATIONAL COMPETENCY PROGRAMS OF ORGANIZED LABOR

A. Working Relationship Between Organized Labor and Vocational Industrial Education

Vocational education and organized labor have, over the years, maintained a close relationship. Union representatives are always included on state and local overall vocational advisory boards, and actively provide advice and counsel as members of craft advisory committees. They are, also, represented on state and local joint apprenticeship committees and on national professional committees, such as the Trade and Industrial Education Divisions Labor-Management Advisory Council for the American Vocational Association.

Many industrial and craft unions carry on intensive education and training programs through special training departments within their organizations. In many states, a close working relationship is maintained between the state apprentice training supervisor and the various unions for which formal apprentice training programs are conducted. The United States Government, through the Department of Labor and its interdepartmental relationship with the United States Office of Education, Division of Adult and Vocational Education, is concerned with apprentice training, as well as the conditions of employment and levels of competency in occupations.

B. Limited Occupational Competency Testing Programs

Contact was made with representatives of national apprenticeship committees and requests submitted regarding the procedures and methods employed in evaluating the competency of apprentices when they reach the level of journeyman competence. A number of locals were also contacted with requests for the same information.

The replies received proved to be disappointing. Evaluations are made on a judgement basis on the job. The research team was unsuccessful in locating any formal testing program, or any tests prepared in addition to those constructed by instructors in training programs. It was concluded that there is a scarcity, if not a void, in the development or administration of special formal occupational competency tests.

V. SURVEY OF OCCUPATIONAL COMPETENCY TESTING PROGRAMS OF THE MILITARY

A. General Observations

Under the Department of Defense, the United States Army, Navy, Air Force and the Coast Guard carry on one of the most diversified and complex training programs ever devised. In a multitude of Bases and Training Centers in the United States and around the world, training programs range from the development of simple office skills to the operation, maintenance and repair of extremely complicated and sophisticated technical equipment.

The very practical aim of all these programs is to develop the individual soldier, sailor or airman to perform his assigned tasks with competence and the highest possible degree of proficiency. Thus, evaluating proficiency is a matter of serious concern for those charged with the training and preparation of personnel. In fact, testing and evaluation personnel in the armed forces has grown to the point where, for the last eleven years, a Military Testing Association has served effectively to conduct annual national conferences in which both military personnel and civilian professional personnel participate.

B. Predominance of Paper and Pencil Types of Competency Tests

In reviewing the literature, it was found that relatively few papers, regarding performance tests, have been published. Perhaps, this is due to the highly specialized nature of the research carried on. The survey team, attempting to obtain information on existing practices of competency testing, made on-site visits to a number of military training centers in which tests were developed and administered.

It was soon recognized that, although a great variety of tests are used, most of those administered are of the pencil and paper type, and that visitations would have to be confined to a selected number of Centers in which performance tests were employed. Among the services for the Army, the Signal Corps Schools, and the Navy, the Electronics Schools were selected for visitation.

Responses from the Air Force indicated that levels of competence of individuals were determined through specialty knowledge tests. Current Air Force Research concentrates on supervisory evaluation of job performance and criteria development.

Much of the testing in all branches of the military relates to: measuring the achievement of trainees in the various service schools, evaluating the validity of the instructional content of each curriculum, appraising the quality of instruction, and evaluating the background, ability and prerating preparation of the trainees.

The discussions held with civilian advisors and military personnel involved in training and competency evaluation, revealed a strong interest in performance testing. Unanimously, they voiced a need for extension and improvement of performance tests presently in use. Even those who were actually involved in their development expressed the need for more accurate and reliable instruments.

C. Patterns for the Construction of Tests for Military Services

The service schools visited were organized with special personnel assigned to bureaus or sections for the development, administration, and control of written and performance tests. Test items are developed by the instructional staff, based on the content of a particular course. The test items are then reviewed by the test specialists for relevance and comprehensiveness, and the tests are used experimentally. Tests are then administered with trainees.

After revision, the test is constructed and applied. Test results are computed and the data analyzed. Item analyses are made, scores are standardized, and mean scores, maximum and minimum scores, and passing levels, are established. Efforts are made to establish item pools for alternate forms.

Where computer service and electronic data processing equipment is available, test item and test analyses are extended through more intensive validity and reliability studies, treatment of variables, and the development of norms.

Performance tests are developed from task analyses derived from job descriptions. In one installation, a special section, fully equipped with apparatus and instruments, was set up for the development of performance tests. The objectives of a test are established for the purpose it is to serve. Then, a step-by-step analysis is conducted by actually carrying out each task. The items to be rated are determined and values are assigned to each item, according to its importance (skill, judgement and procedure) in completing the job. The test is constructed and directtions are developed for the trainee and the test proctor.

Rating forms are prepared and the range for the judgement of the rater is indicated. The test results are then tabulated and recorded. Because of the unavailability of computer service, at this service center, much of the data is hand tabulated. This has placed limitations on the establishment of norms and the making of validity and reliability studies and treating the data statistically. While there is still a good deal of subjective evaluation in the final appraisal, by providing a fairly specific range for rating, the rating results tend to be more objective then was the case several years ago. Actually, the military testing program functions in a setting very much different from civilian life. Motivation and control are different. Nevertheless, the manner in which performance tests are developed, the rating scales applied, and the values assigned, provide a greater measure of objectivity than heretofore.

D. Enlisted Evaluation System

To attract men and extend their military careers, the Army has developed an examination system for the evaluation of comparative competency of enlisted active duty personnel. Established in 1958, the Enlisted Evaluation System has increasingly influenced promotion, training, assignments and increases in pay.

Evaluation is accomplished by the use of a combination of instruments. A paper and pencil test is used to determine the soldier's ability to apply his knowledge, training and experience to the requirements of his military occupation specialty. The enlisted person's efficiency report is the supervisor's appraisal of certain personal characteristics, describing how well the individual actually performs on the job. Performance tests are used when appropriate. The written tests include performance type test items wherever possible, in order to determine how competent an individual is in his military occupational specialty.

The evaluation system is supported by a worldwide network of over three hundred fifty (350) test control officers. There are thirty-two (32) item-writing and ten (10) supervisory agencies that prepare test materials in the Test Development Process. The item-writing agencies are located within the United States Continental Army Command Schools, Department of the Army, and Department of Defense Organizations which are designated as responsible agencies for selected military occupations. Subject matter specialties from these agencies furnish basic reference lists for test aids and provide items or questions for the tests.

The tests are administered in the field by a test officer. The test results are forwarded to the United States Enlisted Evaluation Center. An evaluation score is developed by combining the values of test results, the enlisted person's efficiency report, and performance test score, when used. An evaluation score compares each individual's relative standing with all others who have the same skill level and pay grade in the same military occupational specialty. The ultimate goal is to prepare a test for every military occupational specialty.

E. Overall Observations of Military Testing Programs

A great deal of effort, time and money has been devoted to this evaluation of military personnel program. Test data have been statistically treated and, for a certain number of tests, validation and reliability studies have been completed. Inter-correlations have been established between various test factors. Test items are analyzed. In short, this program, staffed with test specialists and having modern computer facilities available, is considered by the project staff as being the most promising of all test development, administration, and evaluation presently being carried on.

However, there is still a great variation in the methods and procedures employed by the military in developing performance tests at the various military centers. They range from careful analysis of the items to be evaluated and scientific statistical treatment of the data to the personal observation and subjective judgements of examiners who rate assigned tasks which are derived from the instruction content. Careful job analysis of skills and knowledge required on specific pieces of equipment play an important part in establishing examination control. Attempts are being made to reduce subjective judgements. The results of the military establishments in measuring occupational competency, and their scientific efforts to establish the validity and reliability of such measuring instruments and practices, are of substantial value to the National Occupational Competency Project.

PART FIVE

SUMMARY OF OBSERVATIONS AND CONCLUSIONS ON NATIONAL EFFORTS AT OCCUPATIONAL COMPETENCY TESTING

I. OBSERVATIONS OF NATIONAL EFFORTS AT OCCUPATIONAL COMPETENCY TESTING

Attempts at evaluating achievement or competence are as old as the existence of a written language, "There are records of the use of written examinations, about 4000 years ago, in the schools of ancient China". [28] In fact, some form of civil service existed during the reign of the various dynasties which utilized examinations for the selection of civil servants. Among records of ancient Greece have been found documents dealing with the treatment of test data. Walden has stated:

> "2300 years ago, in academic subjects in Athens, complex explanations of statistical treatment of test data were discussed." [29]

A. Major Test Development Efforts Concentrated in Academic Subjects

Present literature contains a wealth of information on continuing test development and procedures, statistical treatment of test results, and the search for better, more accurate, valid and reliable instruments. However, these efforts relate primarily to measurement of human characteristics, such as: abilities, aptitudes, intelligence, emotional stability, occupational interests and related areas.

Achievement testing has largely been confined to academic subjects. The larger number of students involved in such testing programs has provided the impetus for greater effort than has been possible with occupational competency tests. Studies gave such efforts greater priorities. The development of ever-increasing skills in the world of work, and the need to develop these skills in others, requires greater numbers of teachers and increasing needs for developing instruments to evaluate occupational competence.

The search of the literature has shown a sparsity of published information on occupational competency testing. Most of the material identified was in the form of written pencil and paper tests. There is gradual recognition, supported by research, during recent years, that the evaluation of occupational competency in highly skilled areas requires measurement by performance testing. Among the states government agencies, industry and the military contacted, there was a nearly unanimous expression of opinion that occupational competency performance tests are needed for the skilled occupations. Lack of funds, unavailability of adequately trained vocational education testing specialists, and limited testing facilities were cited as deterrents for such test development

B. Efforts of Government Agencies, Industry and the Military

Civil Service Agencies on the federal, state and local levels rely heavily on written examinations. For some fields, performance tests have been developed on a limited scale. A few efforts have been made to standardize and validate such instruments. The major reliance has been on face validity and the authority of occupational specialists. Published data on such tests has not become available.

The response of industry to the survey requests indicated a strong interest in the effort of this project. However, with only a few exceptions, industry relies upon supervisory judgement to appraise occupational proficiency. No published material dealing with proficiency appraisal,through performance tests in industry, was located. It may be assumed that the limited number of firms employing such tests wish to keep the results obtained for internal information only; or, that such information is not available.

In direct contrast, the military has made strong efforts to evaluate the proficiency of military personnel, at least, as part of the overall competence, through performance tests. While there is much variation among the many service schools in the manner in which performance proficiency tests are developed, the greatest progress has been made in the Army Enlisted Evaluation Program, the Signal Corps Training Schools and several Navy Electronics Schools.

The specific nature of the skills required for the highly technical military occupations, the need of preparing the individual for effective performance in his assignment, and the ever-increasing mechanical and electronic complexity of military equipment and machinery have given strong impetus to the establishment of special test development and control groups which are staffed by test specialists. There is an increasing trend to develop, control and maintain written and performance tests for certain areas from a central test development center. A great deal can be learned from these practices which are now carried on.

C. Efforts Among State Vocational Education Units

Among the many states, the procedures of evaluating the occupational competency of tradesmen for teaching in vocational programs differs widely. In sixteen (16) states and twenty (20) teacher education centers, test development has been concentrated on nine (9) major industrial occupations areas. States have duplicated each other's effort. The minimum duplication was three (3) tests developed for the same occupation; the maximum, twenty (20) tests developed by that many institutions for the same occupation. The quality of the tests ranged from fairly elementary measurement of occupational competency to sophisticated levels. Two (2) states have published limited information concerning validity and reliability of only a few tests. No such information was available from the remaining states.

The number of states and institutions concerned with the recruitment, training, and certification of teachers of vocational education was greater than indicated by earlier surveys. However, only three (?) of the states reporting had assigned individuals full time to the development and administration of occupational proficiency tests.

Limitations of funds and lack of qualified personnel have been serious constraints to occupational proficiency test development. Yet, the survey results indicate much duplication of effort among the States and Industrial Teacher Educator Programs. There is a strongly expressed concern that occupational proficiency tests are urgently needed to establish valid and reliable evidence of prospective teacher's occupational competency, which can be used as part of the overall requirements for certification, admission to vocational teacher education programs, and credit towards graduate and undergraduate programs of study.

Research evidence supports the position that written tests alone are not adequate to establish the level of occupationsl competency needed for teaching in vocational programs. While a limited number of states have used written and performance tests for the evaluation of the occupational competence, there is growing recognition that quality should be developed and made available to all states interested in a testing program.

The Military and, to some degree, the Civil Service agencies, have shown the feasibility of using centrally constructed and processed tests.

Although occupational competency tests have been used on a limited scale for many years, there is greater urgency today for better, more efficient and more accurate measuring instruments because of changing conditions under which craftsmen acquire their skills. The findings of the survey of "The State of the Art" point directly to the establishment of a national center for the development and administration of occupational competency tests.

II. CONCLUSIONS ON THE STATE OF THE ART ON NATIONAL OCCUPATIONAL COMPETENCY TESTING EFFORTS

The State of the Art Study provided crystal clear evidence.....

A. That not a single professional testing agency, governmental organization, educational body, labor or management group was satisfied with either the qualitative or quantitative aspects of occupational competency testing;

B. That an exceedingly limited amount of data or experiences relating to occupational competency test development, administration, validation, or research results are recorded;

C. That each organization carrying on significant work in occupational testing recognizes that adequate measures require testing in both the theory (technology) and the skills (performance) of each occupation, that one without the other is not valid;

D. That exceedingly limited numbers of competency tests have been prepared to measure both skill and technological knowledge;

E. That each group recognized its limitations and the need for considerable refinement in the tests and testing program, as well as in the area of supportive research;

F. That in occupational competency testing the test items are related to a grid whose major components are derived from a systematic breakdown and job analysis of the manipulative tasks to be performed and the accompanying related technical knowledge;

G. That validity and reliability have not been established, largely because no vehicle has existed for collectively pooling test data, or even using common test instruments over a large enough population to be able to analyze and synthesize significant findings or experiences;

H. That only limited numbers of highly experienced and skilled occupational competency test construction, administration, and research persons in vocational industrial/technical education and training are engaged full time in this effort;

I. That no single unit, up to this point, has had a combination of sufficient funds, facilities, equipment, personnel, or great enough populations of test participants in one occupational field, to be able to adequately develop, administer or evaluate the results;

J. That the development of complete occupational competency examinations requires substantial investments of human and material resources, significant numbers taking an examination, with the results pooled for statistical analysis and other treatment of the data in establishing norms, and other information that may be studied in depth;

K. That there is excessive unplanned duplication of effort in a restricted number of occupational fields;

L. That there is a serious lack of data and research activity in occupational competency testing;

M. That there is need for nationally pooling of resources and experiences to establish reliability, and validity in economical and efficient ways;

N. That many forms of tests for a single occupational field are needed to serve many different measurement functions for different parts of the occupation and different combinations;

O. That there is no system of depositories or central store of occupational competency test data, test items, test banks;

P. That in vocational education a Consortium of States effort to develop, administer and validate tests requires the investment of significant sums for, at least, twenty (20) major industrial occupations, the employment of competent staff on a full-time basis, supportive "software" and "hardware", and a cooperative arrangement for feedback upon which judgements may be made on the effectiveness of each instrument and the value of test results and testing program.

Concurrent with the State of the Art Study and, as part of the project, interested states were brought together to explore the need for and feasibility of establishing a National Consortium on Occupational Competency Testing. Excerpts from this report on The State of the Art were used as a foundation for reporting conditions as they exist, and the recommendations which were made by the many concerned groups.

Thus, a final conclusion may be added, to the effect that practically all of the states are interested in a vocational/industrial technical occupational competency program and would participate in a national effort. The organizational structure and management functions of this activity is reported as another part of the overall project. At this time, the whole national effort in occupational competency testing is at a significant breakthrough point.

PART SIX

APPENDICES OF RESOURCE MATERIALS AND ORGANIZATIONS

Appendix

A. Selected References

B. Bibliography of Selected Studies and Publications

C. Selected Supplemental Resource Materials

D. Organizations and Institutions Contacted

APPENDIX A

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APPENDIX C

SELECTED SUPPLEMENTAL RESOURCE MATERIALS

Selected resource materials on measurement principles, practices and actual test instruments, developed by and for the military, may be secured from the United States Department of Commerce, National Bureau of Standards, Clearinghouse for Scientific and Technical Information, Springfield, Virginia, 22151.

Achievement Tests, Air Force Personnel
Airman qualifying examination--66 administered as a confidence test.
AD-677 219 5J U69 01 HCS 3.00 HFS 0.65

Achievement Tests, Correlation Techniques
A comparison of four models for making predictions across institutions.
AD-673 5J U68 21 HCS 3.00 MFS 0.65

Achievement Tests, Mathematical Analysis
Use of army school samples in estimating AC8 test validity
AD-677 388 5J U69 01 HCS 3.00 MFS 0.65

Achievement Tests, Supervisory Personnel
A study of the effects of examiner race, sex, and style on test responses of negro examinees
PB-178 901 5J U68 18 HCS 3.00 HFS 0.65

Achievement Tests, Army Personnel
Measurement of achievement motivation in Army security agency foreign language candidates.
AD-623 0-1 U65 23

Achievement Tests, Electronic Technician
Development of an electrical electronic test battery
AD-612 891 U65 09 HCS 3.00

Achievement Tests, Performance (Human)
Confidence, correctness, and difficulty with non-psychophysical comparative judgements
AD-611 979 U65 08

Achievement Tests, Programmed Instruction
Measures on ability and programmed instruction performance
AD-629 443 5H U66 08 HCS 3.00 MFS 0.65

Achievement Tests, Psychometrics
Difficulty and other correlates of criticalness response
AD-600 702 U HCS 3.00

Achievement Tests, Test Construction (Psychology)
Development and preliminary evaluation of the United States Navy automotive knowledge test
AD-627 844 5H U66 06

Aptitude Tests, Air Force Training
Selection of Foreign Students for training in the United States Air Force
AD-683 725 5I U69 09 HCS 3.00 HFS 0.65

Aptitude Tests, Creativity
The predictive validity of certain measures of creativity in machine design
AD-662 696 5J U68 03 HCS 3.00 HFS 0.65

Aptitude Tests, Electronic Technicians
The effect of electronic aptitude on performance of proceduralized troubleshooting tasks
AD-664 889 5I U68 07 MCS 3.00 MFS 0.65

Aptitude Tests, Factor Analysis
A factor analysis of the symbolic-evaluation abilities studies of aptitudes of high-level personnel
AD-464 259 5J U68 19 MCS 3.00

Aptitude Tests, Maintenance Personnel
Effect of Ambiguous test results on troubleshooting performance
AD-661 609 5I U68 07 MCS 3.00 MFS 0.65

Aptitude Tests, Programmers
Evaluation of Tests for improvement of programmer trainee selection
AD-661 609 5I U68 02 HCS 3.00 MFS 0.65

Aptitude Tests, Air Force Personnel
Prediction by career field of first term airman performance from selection and basic training variables.
AD-600 781 U HCS 3.00

Performance on Airman Qualifying Examination by Regional areas and by sex
AD-617 335 U65 16 HCS 3.00

Aptitude Tests, Manpower Studies
Army School Training Performance of Em Scoring Low on Afot,
AD-609 045 U HCS 3.00

Investigation of the United States Navy Clerical Aptitude Test, Form 6,
AD-620 680 51 U66 20 HCS 3.00 HFS 0.65

Aptitude Tests, Personnel Management
Job performance of EM Scoring Low on Afot
AD-602 980 U HCS 3.00

Development of Core Training for F-86D Electronic
Maintenance positions III Derivation of training characteristics
AD-669 399 5I U68 14 HCS 3.00 MFS 0.65

Development of Core Training for F-86-D Electronic
Maintenance Positions IV Principles and Techniques
AD-669 400 5I U68 14 HCS 3.00 MFS 0.65

A Performance-Oriented Electronics Technician Training
Program IV Fleet follow-up evaluation of graduates of all
classes
AD-66 565 5I U68 09 HCS 3.00 MFS 0.65

Electronic Technicians, Performance Tests
An analysis of structure and errors in corrective maintenance
work
AD-666 568 5I U68 09 HCS 3.00 HFS 0.65

Electronic Technicians, Performance Human
A field survey of electronic maintenance technical data
AD-666 990 5I U68 10 HCS 3.00 HFS 0.65

The Assessment of Electronics Corrective Maintenance
Performance II Performance on the AN/SPS-40 by
electronics technicians
AD-673 246 5I U68 19 HCS 3.00 HFS 0.65

Development of Core Training for F-86D Electronic
Maintenance positions II Identification of training
content
AD-669 398 5I U68 14 HCS 3.00 HFS 0.65

Electronics, China
Communist Chinese Scientific Abstracts: Electronics and
Electrical Engineering No. 92
JPRS-43802 9C U68 07 HCS 3.00 HFS 0.65

Electronics, Eastern Europe
East European Scientific Abstracts: Electronics and
Electrical Engineering No. 40
JPRS-43242 9C U68 01 HCS 3.00 HFS 0.65

East European Scientific Abstracts: Electronics and
Electrical Engineering No. 41
JPRS-43492 9C U68 05 HCS 3.00 HFS 0.65

Engineering Personnel, Selection
Qualification Examinations urged for Plant Engineers

Performance Decrement
F F159 Miniature integrating GYRO Sterilization exposure studies
at 300 deg final report
M66-10616 14B S04 01 HCS 3.00 HFS 0.65

Forecasts and Appraisals for Management Evaluation Volume 2
M66-29966 9B S04 16 HCS 3.00 HFS 0.65

Forecasts and Appraisals for Management Evaluation Volume 2
M66-29967 S04 16 HCS 3.00 HFS 0.65

Performance Tests
Individual Task Performance in a changing social structure
AD-601 868 U HCS 3.00

Performance Tests, Air Force Personnel
Describing airman performance in the Administrative Career ladder by identifying patterns of trait ratings
AD-653 544 5I U67 16 HCS 3.00 HFS 0.65

Performance Tests, Air Traffic Controllers
problems in air traffic management IV comparison of pre-employment, job related experience with aptitude tests as predictors of training and job performance of air traffic
AD-603 416 U HCS 3.00

Performance Tests, Army Personnel
Job performance of EM Scoring low on Afot
AD-602 980 U HCS 3.00

Performance Tests, Correlation Techniques
Comparison of Random pairs and real pairs on a simple auditory counting task
AD-638 306 5I U66 20 HCS 3.00 HFS 0.65

Performance Tests, Electronic Technicians
The development and application of absolute scales of electronic job performance
AD-602 392 U HCS 3.00

Performance Tests, Naval Personnel
Post-Training performance criterion development and application

Performance Tests, Reliability
Relation of job qualification ratings to performance ratings of basic training instructors
AD-607 670 U HCS 3.00

Performance Tests, Statistical Data
Studies in research methodology VI the central limit effect for a variety of populations and the robustness of Z, T, and F
AD-612 886 U65 09 HCS 3.00

Performance Tests, Submarine Personnel
Research on the development of shipboard performance measures and performance judgements
AD-610 489 U65 06 HCS 3.00

Performance Tests, Time Studies

Operator Performance Studies: II. Learning analysis from three-plane motions

AD-603 528 U HCS 3.00

Performance Tests, Transfer of Training

A replication of paired-associate learning as a function of S-R similarity.

APPENDIX D

ORGANIZATIONS AND INSTITUTIONS CONTACTED

Organizations in Vocational Education

State Directors of Vocational Education or their equivalent in each State, District of Columbis, Virgin Islands, Puerto Rico.

National Association of State Directors of Vocational Education (All Members).

National Association of Industrial and Technical Teacher Educators (All Members)

National Association of State Supervisors of Trade and Industrial Education (All Members).

Research Committee of the American Vocational Association, Regions I to VIII.

State Vocational Research Centers and Bureaus.

National Vocational Research Center - Ohio State University.

National Vocational Research Center - University of Wisconsin.

Government Agencies

United States Department of Commerce

United States Department of Labor

United States Department of Labor - Office of Manpower Automation and Training.

Equal Employment Opportunity Commission

United States Civil Service Commission

New York State Civil Service Commission

New York State Department of Labor - Internal Training Division
Apprentice Training Division
Manpower Training Division

New York City Civil Service Commission - Professional and Technical Evaluation and Testing Division

Professional Organizations

American Psychological Association, Washington, D. C.

American Educational Research Association, Washington, D. C.

National Council for Measurement in Education, Washington, D. C

Military Testing Association, Governor's Island, New York, New York

Private Organizations

American Institute of Certified Public Accountants
New York City, New York

Associated Personnel Technicians
Wichita, Kansas

Educational Testing Service (visited)
Princeton, New Jersey

Industrial Psychology, Inc.
New York, New York

McAnn Associates
Philadelphia, Pennsylvania

National League for Nursing
New York City, New York

Psychological Institute
Lake Alfred, Florida

The Psychological Corporation (visited)
New York City, New York

The Psychological Research Corporation
New York City, New York

Psychological Services, Inc.
Los Angeles, California

Science Research Association, Inc.
Chicago, Illinois

American Transit Association
New York City, New York

Military

United States Air Force
Lackland Air Force Base, Texas

United States Air Force (visited)
Wright Patterson Air Force Base, Dayton, Ohio

United States Air Force
Lowry Air Force Base, Denver, Colorado

United States Air Force
Personnel & Training, Research Center
San Antonio, Texas

United States Army Ordnance School (visited)
Aberdeen, Maryland

United States Army Signal Corps Training School (visited)
Fort Monmouth, New Jersey

United States Army Enlisted Evaluation Center (visited)
Indianapolis, Indiana

United States Army Armor Training Center
Fort Knox, Kentucky

United States Coast Guard (visited)
United States Coast Guard Training Center
Governor's Island, New York

United States Navy Electronics Laboratory
San Diego, California

United States Navy (visited)
Great Lakes Naval Training Center
Electronics Schools
Great Lakes, Illinois

Trade & Industrial Organizations

American Association of Industrial Management (visited)
New York, New York

American Management Association (visited)
New York, New York

Associated Electrical Industries
New York, New York

National Association of Manufacturers (visited)
New York, New York

National Metal Trades Association
New York, New York

National Tool, Die and Precision Machining Association (visited)
New York, New York

Industrial Companies

A. C. Electronics Division of General Motors
Public Relations Department
Milwaukee, Wisconsin 53201

Air Reduction Company, Inc. (visited)
Personnel Department
New York, New York

American Can Company
New York, New York

American Car and Foundry (visited)
Division A.C.F. Industries, Inc.
New York, New York

American Cyanamid Company
Personnel Division
Wayne, New Jersey

American Telephone and Telegraph Company
New York, New York

Armco Steel Corporation
New York, New York

Bethlehem Steel Corporation (visited)
General Offices, New York, New York

Buick Motor Division
Service Training Department
Flint, Michigan 48550

Cadillac Motor Car Division - General Motors
Service Training Department
Detroit, Michigan 48232

Delco-Moraine Division - General Motors
Personnel Department
Dayton, Ohio 45401

Delco Radio Division - General Motors
Public Relations Department
Kokomo, Indiana 45901

E. I. du Pont de Nemours and Company
Wilmington, Delaware

Foote Mineral Company
Exton, Pennsylvania

General Electric (visited)
New York, New York

General Dynamics Company (visited)
General Education Services
New York, New York

General Motors Corporation
Public Relations
Detroit, Michigan

Inland Steel Products Company
Milwaukee, Wisconsin

International Business Corporation
White Plains, New York

International Mineral and Chemical Corporation
Stokie, Illinois

Mead, Johnson and Company
Evansville, Indiana

Minnesota Mining and Manufacturing Company
St. Paul, Minnesota

Owen-Illinois Glass Company
Toledo, Ohio

Spartan
Division of Spartan Corporation
Jackson, Michigan

Visking Company
Division of Union Carbide Company
Chicago, Illinois

Western Electric Company (visited)
Psychological Testing Department
New York, New York

Western Electric Company - Personnel (visited)
New York, New York

Westinghouse Electric Corporation (visited)
New York, New York

Labor

United Auto Workers
8000 East Jefferson Avenue
Detroit, Michigan 48214

International Association of Machinists & Aerospace Workers
1300 Connecticut Avenue, N. W.
Washington, D. C. 20036

National Joint Steamfitter-Pipe Fitter Apprenticeship Committee
U. A. Building
901 Massachusetts Avenue
Washington, D. C. 20001

National Joint Apprenticeship and Training Committee
for the Electrical Industry
1730 Rhode Island Avenue
Washington, D. C.

United Brotherhood of Carpenters and Joiners of America
Apprentice and Training Department
76 Lamdka Avenue
Staten Island, New York 10308